

ART. XVI.—*Notes on and Additions to Australian  
Fossil Polyplacophora (Chitons).*

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(Communicated by F. Chapman, A.L.S.)

(With Plate XXIV.)

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**Introduction.**

Mr. Francis A. Cudmore has placed in my hands for description a large number of valves of Fossil Chitons, both from the Table Cape beds in Tasmania and the Balcombian beds in Victoria. The Rev. George Cox, of Mornington, and Dr. H. J. Finlay, of Dunedin, N.Z., have also permitted me to study important material from Balcombe Bay. Two species are added to the fossil fauna: one, a unique example of *Ischnochiton (Heterosona) cariosus* Pilsbry, is the first fossil representative of its genus to be found in Australia; the other discovery, for which the new genus *Oöchiton* is instituted, is still more remarkable, the nearest apparent relatives being two rare deep water forms from Cape Horn and Antarctica, one of which is figured for comparison. A discussion of the systematic position of the new discoveries is given and a classified list of the Australian Fossil Polyplacophora is furnished.

**Systematic Description.**

LORICA COMPRESSA Ashby and Torr, 1901.

From the Crassatella Beds, Table Cape, Tasmania, Mr. Cudmore has taken complete, or portions of, 24 median valves and three portions of anterior valves, one almost complete, all referable to the above species.

LORICA COMPRESSA var. AFFINIS Ashby and Torr, 1901.

In the collection is one median valve and two fragments of median valves of this variety in which the longitudinal ribbing is much more widely spaced than is the case in *L. compressa*, s.str.

## LORICA CUDMOREI Ashby, 1925.

From the same bed as the foregoing two imperfect median valves of this species were taken.

Mr. Cudmore has found 32 valves or portions thereof belonging to the genus *Lorica* from one bed. It not only evidences that the genus *Lorica* was numerically very strong in the ancient sea in which this *Crassatella* bed was laid down, but also that this genus of Chitons was almost the only one represented in association with the *Crassatella*. In the seas of to-day the genus *Lorica* is but poorly represented as compared with other groups of Polyplacophora, and it is only recorded from Australasian waters.

## LORICELLA GIGANTEA Ashby and Torr, 1901.

(Plate XXIV., Fig. 9.)

One beautiful example of the head valve of this species is in the collection; it was taken from the Lower Bed, Table Cape, Tertiary (Janjukian).

In the original description the locality was given as Mornington, although thought to have been a mistake. This, the second example of this valve, is a small replica of the holotype, measures  $24 \times 12.5$  mm., and settles the question as to the true locality of the original find. The median valve described by Hull as *Loricella magnifica*, which, as I have already indicated, is referable to this species, was also from Table Cape: I therefore indicate the Lower Bed, Table Cape, as the type locality and horizon.

## Oöchiton, n. gen.

This new genus is proposed for the reception of a new and unique form which is herein described under the name *Oöchiton halli*, n. sp., which species I designate as type of this genus.

The median valve has in common with the genus *Notochiton* a very strongly carinated shell with very steep side-slope, the sutural laminae joined across the middle line, insertion plate in median valve broad, edge smooth, slits 1/1, broad and deep. It differs from *Notochiton* in the absence of regular longitudinal ribbing, and possesses peculiar ovate pustules which stand erect in irregular rows or widely scattered over the whole of the tegmentum; these pustules apparently are associated with the nerve fibres, for most of them have a minute aperture at the summit, and differs also in the greater width of the insertion plate. The name is suggested by the peculiar sculpture which suggests strings of minute eggs.

Since the above definition was written, the tail valve has been discovered. This valve differs widely from the genus *Notochiton*, and, to the best of my belief, is quite unique in its characters. The

upturned and greatly thickened extremity, with the deep sinus immediately behind the mucro and the extended fold of the tegmentum into this sinus, in a limited degree, resemble the genus *Lorica*; the entire absence of the insertion plate immediately behind the mucro together with the greatly thickened extension of the insertion plate laterally with its single slit on either side, faintly reminds one of some members of the Mopaliidae.

The contour of the anterior valve is remarkably like that of *Notochiton mirandus* Thiele, the insertion plate is also similar in being grooved and bevelled, but the slits in *Oöchiton* are proportionally broader. Whereas *Notochiton mirandus* possesses ray-ribs corresponding with the slits, the species under discussion has no ray-ribs and no correspondence between the sculpture and the slits. It will be seen that both the anterior and the median valves show some affinity with the genus *Notochiton*, but the tail valve is strikingly dissimilar and unique. I consider the genus *Oöchiton* more primitive than the genus *Notochiton*, but it might well be placed immediately preceding that genus.

OÖCHITON HALLI, n.sp.

(Plate XXIV., Figs. 1a,b; 2; 3a-c; 8a,b.)

Mr. F. A. Cudmore has placed in my hands two median valves of an entirely new species of Chiton; the one I am making the holotype was found by him at Balcombe Bay, near Mornington, Victoria, Tertiary (Balcombian); the other is also in Mr. Cudmore's collection, and was collected by the late Dr. T. S. Hall at Belmont, Geelong, Victoria, Tertiary (Barwonian), and is separately described herein.

Since writing the following description I have received from the Rev. George Cox, of Mornington, through Mr. R. A. Keble, the Palaeontologist of the National Museum, Melbourne, a tail valve and some additional median valves of the same species. Mr. Cox writes as follows: "The tail valve and several median valves were found [in the Balcombian Beds] at Mornington, by a lad aged 12 years, named Evan Chitts; two median valves and the tail valve were washed out of one cubic inch of clay, and may have belonged to the same animal."

Still more recently Dr. H. J. Finlay of Dunedin, N.Z., has sent me an example of the anterior valve of *Oochiton halli*, which had been collected by himself in the Balcombian beds at Mornington. He is generously allowing me to keep this specimen, which I am describing hereunder as the type of the head valve of this species: up to the present this example of the head valve is unique.

I am naming this interesting species at the suggestion of Mr. Cudmore after the late Dr. T. S. Hall, the discoverer of the first median valve found.

*Median valve.*

Holotype, Balcombe Bay, Victoria. — Pl. (XXIV., Fig. 1a,b). Strongly carinated, very elevated, side-slope straight and steep, angle of divergence  $70^\circ$ , surface smooth and polished, areas indistinguishable, one or two shallow growth lines parallel with the margin towards the girdle. The ornamentation is unique, and consists of six longitudinal broken strings of minute bead-like pustules; the pustules are ovate, and together resemble strings of minute white eggs, which feature has suggested the name of the genus. The first row nearest the jugum has 12 of these pustules; the second has nine only, traverses only half way across the pleural area and is bowed upwards; the third has 14 pustules; the fourth has 9; the fifth has 10; and the sixth has only 2 pustules. It must be noted that all these rows have gaps, the string not being continuous, but this is in some places undoubtedly due to the breaking off of some pustules. The dorsal ridge is slightly raised, anteriorly a little broader than at the beak, and in a faint degree is subgranulose. The foregoing is as seen under a simple lens,  $\times 20$ .

Under a Zeiss binocular microscope,  $\times 65$ , some very interesting features are made clear. The whole of the surface of the shell is highly polished, and everywhere thickly perforated with megalopores. It is also transversely, concentrically crossed by numerous growth grooves or lines, these running across the jugum from side to side. To these grooves is due the apparent subgranulose appearance of the dorsal ridge. The bases of detached pustules are visible, the pustules themselves are definitely ovate, attached by the smaller end and almost vertical; each pustule has a small perforation at the summit, looking like a black dot, which is a little larger than the megalopores of the normal surface of the shell; except for this aperture the pustules are solid, not hollow, as in *Protochiton*. The channel connecting nerve fibres with the black dot can be seen in places where the pustules have been broken. Corresponding with the rows of pustules is an irregular series of deep pits with a black, probable eyedot at the bottom; these rows of pits are on the lower and outer side of the pustules, and are overhung and almost hidden by these. The perforations at the base are much larger than the megalopores, and therefore must have functioned much like what are known as "eyes" in recent species. This description is taken from the right side of the shell; the other had met with some injury during life, and the process of mending has caused the outer part of the lateral area to bend upwards, and the strings of egg-shape pustules have somewhat merged into one another. The inside of the valve is white, and the tegmentum is folded over at the beak, the margin of the fold being coarsely pustulose.

Dimensions.—The holotype, median valve, is 4.5 mm. in width and 3.75 mm. in length; angle of divergence,  $70^\circ$ .



Paratype, Belmont.—(Pl. XXIV., Fig. 2). Median valve, beaked, carinated, side-slope very steep, dorsal area arched except near the beak, where it is narrowed to a mere ridge, smooth except for several narrow ridges unsurmounted by pustules, separating this area from the pleural. The character of the strings of egg-like pustules is similar to that of the type, but the rows are shorter and in places a narrow ridge connects widely-spaced pustules; near the insertion plate, grains are scattered. The sutural laminae are broken, but are joined across the centre line; the lateral area is separated from the pleural by a shallow diagonal fold. The colour of the tegmentum is silvery grey, the pustules opaque white. The pitting, although present, does not appear to be associated with the pustules, as is the case in the holotype. Interior creamy white, insertion plate undamaged on one side, teeth sharp, slits 1/1, well-defined and broad, callus imperceptible, tegmentum extensively folded over at the beak forming a "pocket." This median valve, Nat. Mus. No. 13497, is longitudinally narrow, measuring  $4 \times 3$  mm.; dorsal area without pustules.

Paratypes, Balcombe Bay.—No. 1 measures  $4.25 \times 3.75$ ; No. 3 certainly has the articulamentum joined across the middle line between the sutural laminae; No. 4 is imperfect, has a V-shaped notch in the articulamentum between the sutural laminae; No. 5 is fragmentary, dorsal area ornamented with egg-shaped pustules but without raised dorsal ridge; No. 6 is a fragment only.

#### *Tail valve.*

Paratype, Balcombe Bay. (Type of tail valve.)—(Pl. XXIV., Fig. 3a-c.). Small, measuring longitudinally 2.75 mm., laterally 2.25 mm., very strongly carinated; mucro at the posterior margin or more correctly subposterior, because the tegmentum is bent over at the mucro and turned down vertically; the portion immediately behind the mucro is concave and in this cavity or sinus, are two of the egg-shaped pustules common to the sculpture of the rest of the tegmentum; from the mucro is a raised diagonal rib or fold, the strings of egg-shaped pustules of the pleural area are continued across this fold to the posterior edge of valve. This valve is upturned at the mucro and the extremity very much thickened, the insertion plate here is subobsolete, and reduced to a mere callus or ridge behind the mucro, but on either side the insertion plate is developed into a highly thickened extension of the articulamentum with one diagonal slit on either side, and in addition on one side a supplementary groove, but not a true slit. The sutural laminae are well developed, the sinus between being very narrow, and are joined to the thickened posterior insertion plate by a broad extension of the articulamentum which is suggestive of the *Acanthochitonidae*.

*Anterior valve.*

Paratype, Balcombe Bay. (Type of anterior valve).—(Pl. XXIV., Figs. 8a,b.). Valve highly elevated, apex slightly recurved, anterior slope very steep and concave (due to recurved apex). The ornamentation consists of strings of egg-like pustules similar to those in the other valves; the arrangement is generally speaking longitudinal, the strings commencing at the posterior margin and continuing to the insertion plate with considerable irregularity, several strings bifurcate, and in some places there are short intermediate rows; the strings or rows of pustules do not seem to have any relationship with the slits in the insertion plate.

Articulamentum, or inner layer of shell creamy white, highly polished, smooth, without any grooves; the tegmentum infolded at the apex, this infolded portion is thickly studded with the egg-like pustules; the insertion plate is well produced, perfect, except for a few minute chips; slits 7, broad and short, spacing irregular; the upper side of the insertion plate is numerously grooved, the plate is broad and proportionally thick, but the upper edge is bevelled off, so that the actual edge is sharp, the grooves not continuing to the inner edge. Valve measures  $4.5 \times 2.25$  mm.

## NOTOCHITON MIRANDUS Thiele.

(Plate XXIV., Figs. 4, 5, 6a,b.)

(*N. mirandus* Thiele, Subantarktischen Chitonen, pp. 12, 13.)

In the preparation of this paper comparisons have had to be made with this species, of which I have in my collection a cotype given to me by Major Dupuis. Pilsbry does not refer to it, Thiele (in *Revis. des Syst. der Chitonen*, p. 107) neither figures nor describes it, making a bare reference and stating that Edgar Smith considered it a *Chetopleura*, but Thiele considers it allied to the genus *Nuttallochiton*, and is probably correct. For purposes of comparison with *Oöchiton halli*, n. sp., figures are given.

## ISCHNOCHITON (HETEROZONA) CARIOSUS Pilsbry, 1892.

(Plate XXIV., Fig. 7.)

The Rev. George Cox has sent me a single median valve of the above *Ischnochiton*, collected by Master Evan Chitts in the Balcombian Beds at Mornington. This is the first true record<sup>1</sup> of the discovery of a fossil *Ischnochiton* in Australia.

This example appears to have a well-defined diagonal rib, and for that reason I at first thought it would likely prove to be a new species, but on careful examination I find that this apparent

1.—F. Chapman was in error when he referred *Protochiton granulatus* to this genus (*Proc. Roy. Soc. Vic.*, n.s., xx. (2), pp. 218-220, 1908).

feature is due to a slight wearing of the anterior of the raised lateral area. As compared with a half-grown example from Marino in South Australia, in which the valves are of a corresponding size, I find the sculpture similar, though a little more deeply cut, in this respect corresponding with the form from Western Australia, but it differs slightly in that the infolding of the tegmentum under the jugum is about double the width as compared with the Marino example, but in the lateral extension of this infolding it is similar. There are no differences to be distinguished in this valve to justify separation, but such may be revealed when fossil end valves are discovered. The fossil valve measures  $5.5 \times 2.25$  mm.

### Discussion on Classification.

I have retained the genera *Lorica* and *Loricella* under Pilsbry's subfamily Liolophurinae, while recognising that this is not their true setting. Thiele found that the radula showed relationship with the Ischnochitonidae, and treated these genera as advanced forms of that group, but I feel that more work needs to be done on characters other than that of the radula, before their true niche in the Natural Taxis can be determined. I therefore retain them in the setting in which Pilsbry placed them, until the study of this problem, from the points of view suggested above, supplies added data upon which we may form a considered opinion.

All students of the Polyplacophora are greatly indebted to Dr. Thiele for the specialized work he has done in the radula of that order. He has laid a good foundation, and it is unfortunate that since the production of his valuable work, "Revision des Systemes der Chitonen," no material work has been done on the radula of this group. One should hesitate to accept too hastily conclusions based chiefly on one feature alone, until such time as other supporting features have been studied and made known.

Thiele has pointed out that in the family Lepidopleuridae there is some variation in the characters of the radula. Iredale and Hull have assumed that this discovery of Thiele's means that the absence of insertion plates and other accepted primitive characters, are the result of degeneracy, and have founded their classification on this assumption. Thiele himself drew no such conclusion from his discovery, and proposed a suborder, Lepidopleurina, for this group, numbering it (I.). I feel sure a right conception of taxonomic values will endorse Thiele in his treatment, and I have suggested that the Chitons living in the seas of to-day have not arisen from primitive stock in one phylum alone, but through more than one. This I have demonstrated in the case of the Acanthoid group, and have expressed the opinion that the existence of divergences in the radula of members of the Lepidopleuridae is

important evidence that gathered together in this group are the progenitors of more than one phylum that have developed along parallel lines.

The discovery, in addition to the median ones, of the end valves of the fossil *Protochiton granulosus* (Ashby and Torr), has made it quite clear that this species could not have been derived through any members of the Lepidopleuridae, and its evident relation to the Acanthoid Group of Chitons makes necessary a partial revision of our previous conception of the Classification of Polyplacophora.

This revision was foreshadowed in my Phylogenetic Diagram, page 75 (1.c.); I have endeavoured in the following Classification List to give expression to this revised conception, made necessary by the recent discoveries named above.

The proposal of Iredale and Hull to substitute the word "Loricates" for the universally used "Chitons," dating as this latter does from the days of Linné, surely can commend itself to no one. The proposal to substitute the word "Loricata" for "Polyplacophora," and "Cryptoconchidae" for "Acanthochitonidae," is not compulsory, and surely can serve no good purpose. The law of priority does not apply to ordinal and family names; also the use of the term "Type Genus" is understood by most workers to mean "typical genus," which the specialized form *Cryptoconchus* certainly is not.

Since the issue of my Monograph on Australian Fossil Polyplacophora, Iredale and Hull have described the cast of a Chiton from the Permo-Carboniferous beds of Bundanoon, New South Wales, and have called it *Permochiton australianus*. This specimen is a very interesting one, in face of the fact that Etheridge's *Chelodes calceoloides* has already been disallowed, for although its true character is still in doubt, there seems a consensus of opinion that it is not a representative of the order Polyplacophora; *Permochiton australianus* comes from the oldest series of beds in which Chitons have yet been found in Australia. These gentlemen suggest some resemblances between *P. australianus* and the genera *Ischnochiton* and *Lepidopleurus*, but judging from their figures I can see no resemblance, though certainly there is a general resemblance to the Palaeozoic genus *Helminthochiton*, and it is quite natural to suppose that members of that genus would persist from the Carboniferous into the Permo-Carboniferous.



## Classification of Australian Fossil Polyplacophora.

## Class AMPHINEURA.

Order POLYPLACOPHORA (Blainville em.) Gray, 1821.

## [PRIMITIVE.]

Suborder EOPLACOPHORA Pilsbry, 1900.

## [FOSSIL ONLY.]

Family GRYPHOCHITONIDAE Pilsbry, 1900.

Genus PERMOCHITON Iredale and Hull, 1926 (without definition).

*Permochiton australianus* Ire. and Hull, 1926.

Suborder PROTOCHITONINA Ashby, 1928.

Family PROTOCHITONIDAE Ashby, 1925.

Genus PROTOCHITON Ashby, 1925.

*Protochiton granulatus* (Ashby and Torr, 1901).

Family ACANTHOCHITONIDAE Hedley, 1916.

Subfamily AFOSSOCHITONINAE Ashby, 1925.

Genus AFOSSOCHITON Ashby, 1925.

*Afossochiton cudmorei* Ashby, 1925.*A. rostratus* (Ashby and Torr, 1901).

## [ADVANCED.]

Subfamily ACANTHOCHITONINAE Ashby, 1925.

Genus ACANTHOCHITON Gray em., 1821.

*Acanthochiton chapmani* Ashby, 1925.

Subfamily CRYPTOPLACINAE Thiele, 1910.

Genus CRYPTOPLAX Blainville, 1818.

*Cryptoplax pritchardi* Hall, 1905.*C. gatliffi* Hall, 1905.

## [PRIMITIVE.]

Suborder LEPIDOPLEURINA Thiele, 1910.

Family LEPIDOPLEURIDAE Pilsbry, 1892.

Genus LEPIDOPLERUS Risso, 1826.

*Lepidopleurus magnogramifer* Ashby, 1925.

[ADVANCED.]

Suborder CHITONINA Thiele, 1910.

Family CALLOCHITONIDAE Thiele, 1910.

Subfamily TRACHYDERMONINAE Thiele, 1910.

Genus NOTOCHITON Thiele.

*Notochiton mirandus* Thiele. Recent.

*N. hyadesi* Rochebrune, 1889. Recent.

Genus OÖCHITON Ashby, n. gen.

*Oöchiton halli* Ashby, n. sp.

Family MOPALIIDAE Pilsbry, 1892.

Genus PLAXIPHORA Gray, 1847.

*Plaxiphora concentrica* Ashby and Torr, 1901.

Family ISCHNOCHITONIDAE Pilsbry, 1892.

Subfamily ISCHNOCHITONINAE Pilsbry, 1892.

Genus ISCHNOCHITON Gray, 1847.

Subgenus HETEROZONA (Cpr. MS.) Dall, 1878.

*Ischnochiton (Heterozona) cariosus* Pilsbry, 1892.

Subfamily CALLISTOPLACINAE Pilsbry, 1892.

Genus CALLISTOCHITON Carpenter, 1882.

*Callistochiton meridionalis* Ashby, 1919.

Family CHITONIDAE Pilsbry, 1892.

Subfamily CHITONINAE Pilsbry, 1892.

Genus CHITON Linné, 1758.

Subgenus RHYSSOPLAX, Thiele, 1893.

*Chiton (Rhyssoplax) fossicius* Ashby and Torr, 1901.

Subfamily LIOLOPHURINAE Pilsbry, 1893.

Genus LORICA H. and A. Adams, 1852.

*Lorica compressa* Ashby and Torr, 1901.

*L. compressa* var. *affinis* Ashby and Torr, 1901.

*L. cudmorei*, Ashby, 1925.

Genus PROTOLORICA Ashby, 1925.

*Protolorica atkinsoni* Ashby, 1925.

Genus LORICELLA Pilsbry, 1893.

*Loricella gigantea* Ashby and Torr, 1901.

*L. paucipustulosa* Ashby and Torr, 1901.

Subgenus PSEUDOLORICELLA Ashby, 1925.

*Loricella (Pseudoloricella) sculpta* Ashby, 1921.

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ASHBY, E. Monograph on Australian Fossil Polyplacophora. *Proc. Roy. Soc. Vic.*, n.s., xxxvii. (2).

#### EXPLANATION OF PLATE XXIV.

- Fig. 1.—*Oöchiton halli*, n. sp. Balcombe Bay, Vic.; Balcombian. Holotype, median valve. (a) side view, ornamentation and broken insertion plate,  $\times 7$ ; (b) upper side,  $\times 7$ . Nat. Mus. No. 13496.  
Fig. 2.—*O. halli*, n. sp. Belmont, Vic.; Balcombian. Paratype, median valve, showing ornamentation and complete insertion plate,  $\times 6.5$ . Nat. Mus., No. 13497.  
Fig. 3.—*O. halli*, n. sp. Balcombe Bay, Vic.; Balcombian. Paratype, taken as type of tail valve. (a) posterior of valve tilted upwards, to show truncated posterior, also ornamentation,  $\times 6.5$ ; (b) side view, showing complete insertion plate, slit and truncated posterior,  $\times 7$ . Nat. Mus. No. 13494.  
Fig. 4.—*Notochiton mirandus* Thiele. Antarctica, dredged: Recent. Cotype, anterior valve, side view showing insertion plate and sculpture for comparison with *Oöchiton halli*,  $\times 5$ . Ashby Coll.  
Fig. 5.—*N. mirandus* Thiele. Median valve, side view.  $\times 5$ . Ashby Coll.  
Fig. 6.—*N. mirandus* Thiele. Tail valve. (a) side view showing sculpture, mucro and insertion plate,  $\times 5$ ; (b) same valve, inside, showing teeth,  $\times 7$ . Ashby Coll.  
Fig. 7.—*Ischnochiton (Heterozona) cariosus* Pilsbry. Balcombe Bay; Balcombian. Median valve,  $\times 7$ .  
Fig. 8.—*Oöchiton halli*. Ashby. Balcombe Bay; Balcombian. Paratype, here taken as type of anterior valve. (a) showing sculpture and insertion plate,  $\times 6$ ; (b) side view, showing anterior slope, sculpture and insertion plate,  $\times 12$ . Ashby Coll.  
Fig. 9.—*Loricella gigantea*. Ashby and Torr. Table Cape, Tas., Lower Bed; Janjukian. Anterior valve showing shape and sculpture,  $\times 3.5$ . Nat. Mus. No. 13499.